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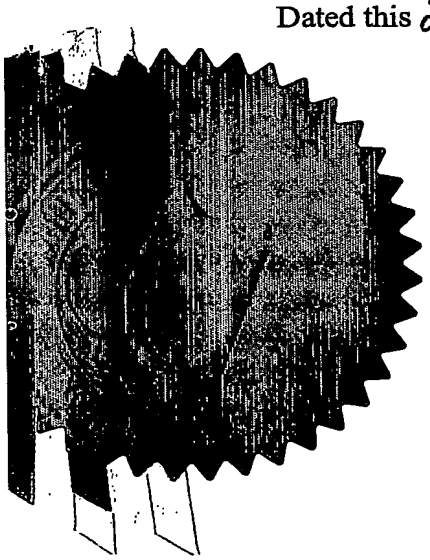
Application No.	S2003/0023
Date of Filing	17 January 2003
Applicant	HEARTSINE TECHNOLOGIES LIMITED, a British Company of Thomas Andrews House, Queen's Island, Belfast BT3 9DU, United Kingdom

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

Dated this 21 day of January 2004.



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S030023

Application No.

FORM NO. 1

REQUEST FOR THE GRANT OF A PATENT
PATENTS ACT, 1992

The Applicant named herein hereby request

_ the grant of a patent under Part II of the Act

X the grant of a short-term patent under Part III of the Act

on the basis of the information furnished hereunder.

1. **APPLICANT**

Name	**HEARTSINE TECHNOLOGIES LIMITED**
Address	**Thomas Andrews House, Queen's Island, Belfast BT3 9DU, United Kingdom**
Description/Nationality	**A British Company**

2. **TITLE OF INVENTION**

"Disposable defibrillator electrode assembly"

3. **DECLARATION OF PRIORITY ON BASIS OF PREVIOUSLY FILED APPLICATION FOR SAME INVENTION (SECTIONS 25 & 26)**

Previous filing date	Country in or for which filed	Filing No.

4. **IDENTIFICATION OF INVENTOR(S)**

Name(s) of person(s) believed by Applicant(s) to be the inventor(s)

1. William J Smirles
2. Johnny H Anderson

Address

1. 1260 Anthony Lane, Deerfield, Illinois 60015, United States of America.
2. 58 Ardmore Road, Holywood, County Down, BT18 0JP, United Kingdom.

5. **STATEMENT OF RIGHT TO BE GRANTED A PATENT (SECTION 17(2)(B))**

The Applicant company has obtained the right to be granted a Patent by virtue of the terms of employment between the Inventors and the Applicant Company.

6. **ITEMS ACCOMPANYING THIS REQUEST - TICK AS APPROPRIATE**

(i)	X	prescribed filing fee (€60.00)
(ii)	X	specification containing a description and claims
	_	specification containing a description only
	X	Drawings referred to in description or claims
(iii)	_	An abstract
(iv)	_	Copy of previous application(s) whose priority is claimed
(v)	_	Translation of previous application whose priority is claimed
(vi)	X	Authorisation of Agent (this may be given at 8 below if this Request is signed by the Applicant(s))

7. **DIVISIONAL APPLICATION**
The following information is applicable to the present application which is made under Section 24 -

Earlier Application No:
Filing Date:

8. **AGENT**

The following is authorised to act as agent in all proceedings connected with the obtaining of a Patent to which this request relates and in relation to any patent granted -

Name
F. R. KELLY & CO.

Address
at their address as recorded for the time being in the Register of Patent Agents

9. **ADDRESS FOR SERVICE (IF DIFFERENT FROM THAT AT 8)**

HEARTSINE TECHNOLOGIES LIMITED
F. R. KELLY & CO.

By: _____
EXECUTIVE

Date: January 17, 2003.

Disposable Defibrillator Electrode Assembly

This invention relates to a disposable electrode assembly for a portable defibrillator.

Portable defibrillators have been available for the last 20 years. The operation of these devices has always involved, at minimum, three actions: (1) applying a power source to the device (either through a battery pack or a mains plug), (2) plugging a set of defibrillation electrodes (pads) into the device and applying the electrodes to the patient's bare chest, and (3) turning the device on (either via an on/off button or opening a lid, etc.).

In a public situation, e.g. a railway station, airport or the like, it is desirable that the device be operable by a lay member of the public without undue complication.

Accordingly, it is an object of the invention to simplify the operation of a portable defibrillator, at least to the extent that steps (1) and (2) above are combined.

According to an aspect of the present invention, there is provided a disposable electrode assembly as specified in claim 1.

It is a subsidiary object of the invention also to eliminate step (3) above, so that a single action will power the defibrillator and turn it on.

A subsidiary benefit of the invention is that in conventional defibrillation using disposable pads and batteries, battery management must be carefully considered and constantly monitored. The present invention separates the process of battery management from the defibrillation process by incorporating the power source for the defibrillator within the disposable electrode assembly.

The invention is also directed to a method by which the described apparatus operates and including method steps for carrying out every function of the apparatus.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic diagram of a first embodiment of the invention;

Fig. 2 shows a modification of the embodiment of Fig. 1;

Figs. 3 to 9 are schematic diagrams of further embodiments of the invention; and

Fig. 10 is an exploded perspective view of a practical implementation of the embodiment of Fig. 7.

In the drawings, the same or equivalent components have the same reference numerals.

Referring to Fig. 1, a first embodiment of disposable electrode assembly 10 for a portable defibrillator 12 comprises a pair of defibrillation electrodes (hereafter referred to simply as "pads") 14 hermetically sealed in a pouch 16 from which they may be removed for use by removing a "tear-off" strip 17. Flexible electrically conductive leads 18 connect the pads 14 to respective ones of a pair of outer terminals 20 of a connector 22. The connector 22 also houses a set of batteries 24 which are connected in series across a pair of inner terminals 26 of the connector 22.

In use the connector 22 is plugged into a complementary connector 28 of the defibrillator 12. The complementary connector 28 has a pair of outer terminals 30 which are engaged by the terminals 20 of the connector 22, and a pair of inner terminals 32 which are engaged by the terminals 26 of the connector 22. Thus, the terminals 26 of the connector 22 are power output terminals which in use supply power to the defibrillator 12 via the terminals 32, while the terminals 20 of the connector 22 are high voltage input terminals which receive from the defibrillator 12, via the terminals 30, a defibrillation voltage for application to the pads 14.

The defibrillator 12 may be turned on automatically by insertion of the connector 22 into the connector 28, or it may be turned on by some further action as will be described. In any event, save for the location of the batteries in the connector 22, in all other respects the defibrillator may be entirely conventional.

Fig. 2 shows a modification to Fig. 1, where the pouch 16 contains a voice module 34 comprising a speaker 36, a speaker IC 37, and its own power cell 38. This is activated upon removing the tear-off strip 17 to give spoken instructions to the lay user how to plug in the connector 22 from which point the defibrillator itself shall take over the operation. Voice modules 34 are well known and used, for example, in the novelty greetings card industry.

In another embodiment, Fig. 3, the power supply circuit which connects the batteries 24 in series within the connector 22 includes a spring biased contact 39. This is biased towards a counter contact (not shown) but is maintained out of engagement with such counter contact by an insulating tab 40 interposed between the two. Removal of the tear-off strip 17 to open the pouch 16 pulls the tab 40 from under the contact 39, allowing it to engage its counter contact and thus automatically complete the power supply circuit within the connector 22.

A variation of this includes means for sensing when the pads 14 are separated, Fig. 4, by low power monitoring circuitry internal to the defibrillator 12 which checks to see if an electrical connection 41 between the pads 14 has been broken. The defibrillator 12 turns itself on when the connection 41 is sensed as broken, meaning that the pads 14 have been removed from the pouch 16 and separated. One way of doing this is shown in the circuit diagram of Fig. 4A.

The pads 14, here individually referenced 14A and 14B to distinguish one from the other, are mounted on a release liner 15 within the pouch 16 (not shown). The connection 41, having a resistance R3, is also mounted on the liner 15 and creates an electrical link between the two pads 14A and 14B. As described, the pads 14A and 14B are attached to the connector 22 containing the batteries 24 which supply a voltage V_{batt}.

When the connector 22 is plugged into the defibrillator 12 the pads 14A and 14B are connected to a changeover unit 80 (such as a relay) having changeover contacts 82. Initially, as seen in Fig. 4A, the changeover contacts 82 connect the pad 14A to V_{batt} and the pad 14B to ground via a resistor R1 and to the source of an FET Q1. This forms a circuit in which the source of Q1 is pulled up to V_{batt} via R3, resistor R1 being sufficiently large that current drain from V_{batt} and the pull down effect with respect to R3 is minimised. V_{batt} is also be applied to the gate of Q1 and to a resistor R2 pulling up the drain of Q1. Resistor R2 is sufficiently large that current drain from V_{batt} is minimised. This state is maintained as long as the pads 14 remain attached to the release liner 15.

To turn the defibrillator on, either or both pads 14 are removed from the release liner 15. This breaks the circuit formed by R3 which pulled the source of Q1 to V_{batt}, so that the source of Q1 is now pulled to ground via R1. This turns on Q1 and in doing so pulls down the voltage at the drain of Q1 to a value determined by the divider created by R2 and R1. This voltage drop 84

is detected by the defibrillator control circuitry (not shown) which responds by switching over the contacts 82 to connect the pads 14A and 14B to respectve high voltage terminals HV1 and HV2 within the defibrillator.

The embodiments of Figs. 3 and 4 assume that the connector 22 is, in use, already plugged into the defibrillator 12, so the battery power is only required to be applied when the pads are actually deployed for use. This contrasts with the embodiment of Fig. 1 where it is assumed that the connector 22 is not pre-connected to the defibrillator 12, so that the mere act of plugging it in can apply power and turn the defibrillator on.

In the embodiment of Fig. 5 the batteries are not housed in the connector 22 but instead a flat battery pack 42 is mounted on the rear of one or both pads 14. This requires extra wires 44 to the connector 22 to carry the power. As shown in Fig. 6, and similar to the embodiment of Fig. 3, the power supply circuit may include a spring contact 39 biased against a counter contact 46 but normally held electrically disconnected therefrom by an insulating tab 40. The tab 40 is fixed to a release liner 48 such that, when the liner 48 is on the pad 14, the tab 40 is interposed between the contacts 39 and 46. However, when the liner 48 is removed from the pad 14 the tab 40 is withdrawn from between the contacts 39 and 46 to complete the power circuit and power up the defibrillator 12 for use.

In the embodiment of Fig. 7, when the pads 14 are not in use they are stowed (attached, for example, by

Velcro) in a shallow depression or recess 50 in the defibrillator 12 housing and the connectors 22 and 28 are pre-engaged (in Fig. 7 the two connectors are shown as a single item 22/28 for simplicity). In this case the batteries 24 are housed in the connector 22, as in Fig. 1. Within the defibrillator 12 the power supply circuit includes a pair of contacts 52 and 54 which are biased towards one another but normally held apart by an insulating pin 56 which is removably inserted into the defibrillator housing from outside. This pin 56 also cooperates with the pad leads 18 (or with the pads 14 themselves) such that when the pads 14 are removed from the recess 50 the pin 56 is automatically removed from between the contacts 52, 54 so that power from the batteries 24 is automatically connected to the defibrillator 12.

The embodiment of Fig. 8 is similar to that of Fig. 7 except that the batteries 24 are again no longer housed in the connector 22 but come in the form of a flat battery pack 58 housed, together with the pads 14, in a tray 60 which fits in the recess 50. In this case either the act of removing the pads from the tray, or the act of removing the tray, removes the pin 56 from between the power contacts 52, 54.

Fig. 9 shows a variation of Fig. 7 wherein one of the pads 14 is fixed to the rear of the defibrillator 12 housing and its electrical connection to the defibrillator is either made directly through the defibrillator housing via a contact 62 in the housing wall or via a lead 18 and the connectors 22/28 as in Fig. 7 (where the connection to the pad 14 is made

directly via the contact 62 there will only need to be one terminal 20 on the connector 22 and correspondingly only one terminal 30 on the connector 28). In this embodiment the operation is similar to that of Fig. 7 except that the defibrillator 12 itself is placed on the patient's chest and effectively becomes one of the patient pads. The other pad 14 performs the device turn-on operation as by pulling out the mechanical block (pin 56) in the power supply circuit when it is pulled away from the defibrillator 12.

Fig. 10 is an exploded perspective view of a practical implementation of the embodiment of Fig. 7 (the leads 18 are not shown). The defibrillator 12 comprises upper and lower housing halves 12a and 12b which contain a digital printed circuit board (PCB) 70 and a high voltage PCB 72. The batteries 24 are accommodated in the connector 22 which plugs into the socket connector 28 in the upper housing half 12a. The recess 50 is formed in the lower housing half 12b and contains the pads 14 when they are not in use. The insulating member 56 enters a slot 74 in the lower housing half 12b to be interposed between the contacts 52 and 54 (Fig. 7) and is operatively coupled to the pads 14 and/or their leads so that it is withdrawn from the slot 74 when the pads are removed from the recess 50.

The invention is not limited to the embodiments described herein which may be modified or varied without departing from the scope of the invention.

Claims

1. A disposable electrode assembly for a portable defibrillator, the assembly comprising at least one defibrillator electrode, at least one battery for powering the defibrillator, and a connector for connecting the electrode and battery to the defibrillator, the connector having power output terminals for connecting the at least one battery to the defibrillator and at least one high voltage input terminal for applying a defibrillation voltage to the at least one electrode.

2. An assembly as claimed in claim 1, wherein the battery is housed in the connector.

3. An assembly as claimed in claim 1, wherein the battery is mounted on the rear of the defibrillation electrode.

4. An assembly as claimed in any preceding claim, wherein the assembly comprises two defibrillation electrodes.

6. An assembly as claimed in any one of claims 1 to 3, wherein the assembly comprises one defibrillator electrode, a second defibrillator electrode being attached to the exterior of the defibrillator housing.

7. An assembly as claimed in any preceding claim, wherein the electrode is sealed in a pouch and further

including means for completing a power supply circuit to the power input terminals upon opening the pouch.

8. An assembly as claimed in claim 4, wherein the defibrillation electrodes are electrically connected externally of the defibrillator by a frangible connection which is broken when the electrodes are deployed for use.

9. An assembly as claimed in any one of claims 1 to 6, wherein the defibrillation electrode has a stowage location on the defibrillator housing and removal of the electrode from the stowage location automatically connects power to the defibrillator

10. An assembly substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

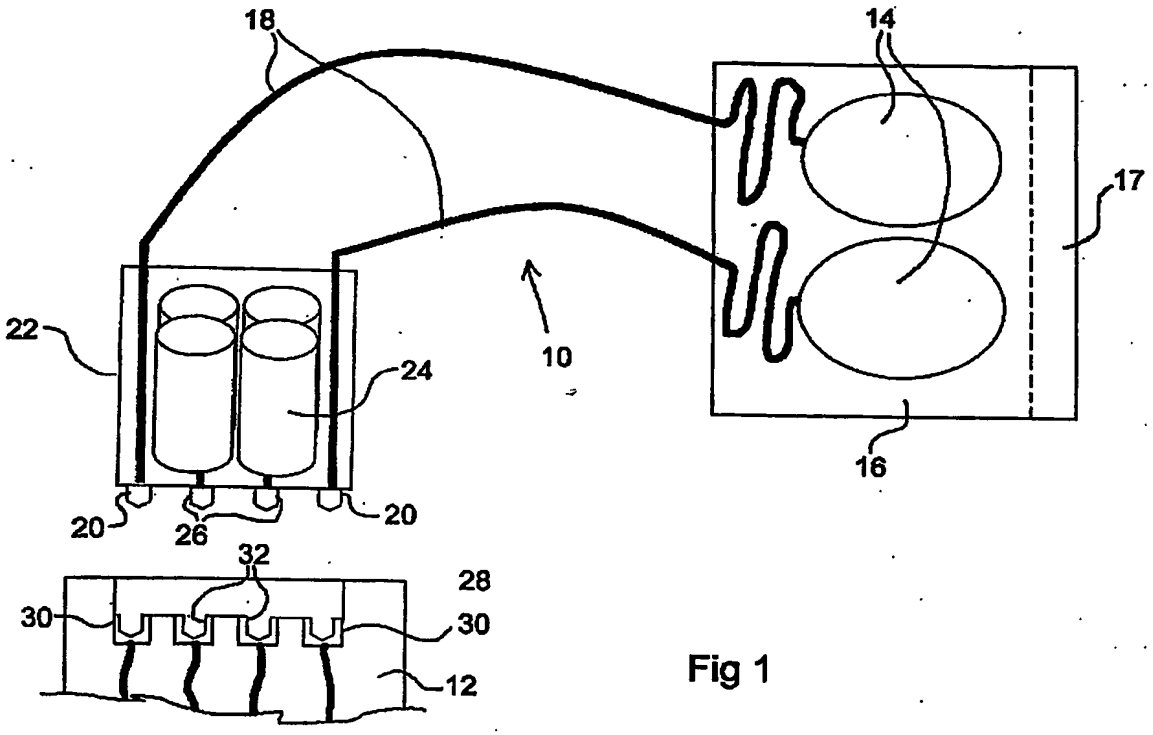
18
14
17
22
24
10
20
26
20
16
32
28
30
30
12

Fig 1

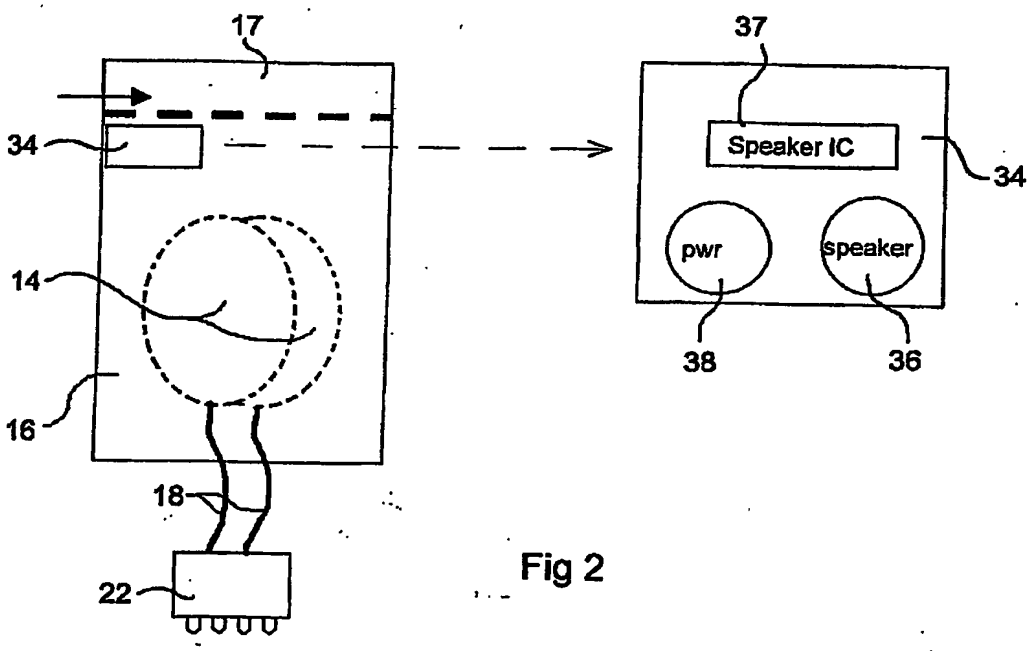
17
37
34
Speaker IC
34
14
pwr
speaker
16
38
36
18
22

Fig 2

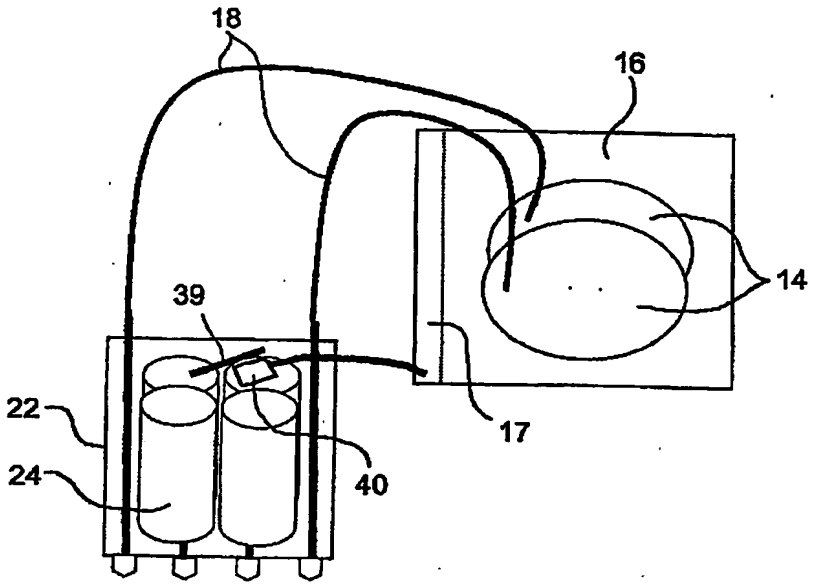

Fig 3

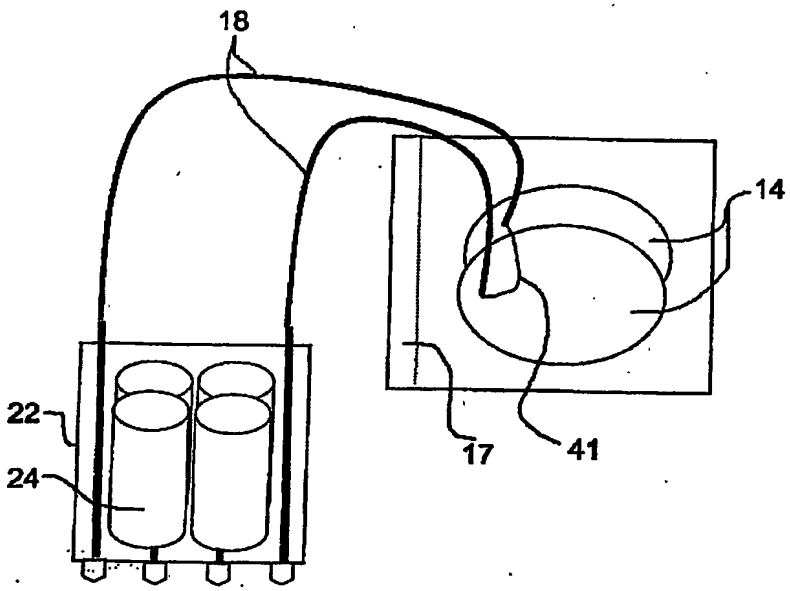

Fig 4

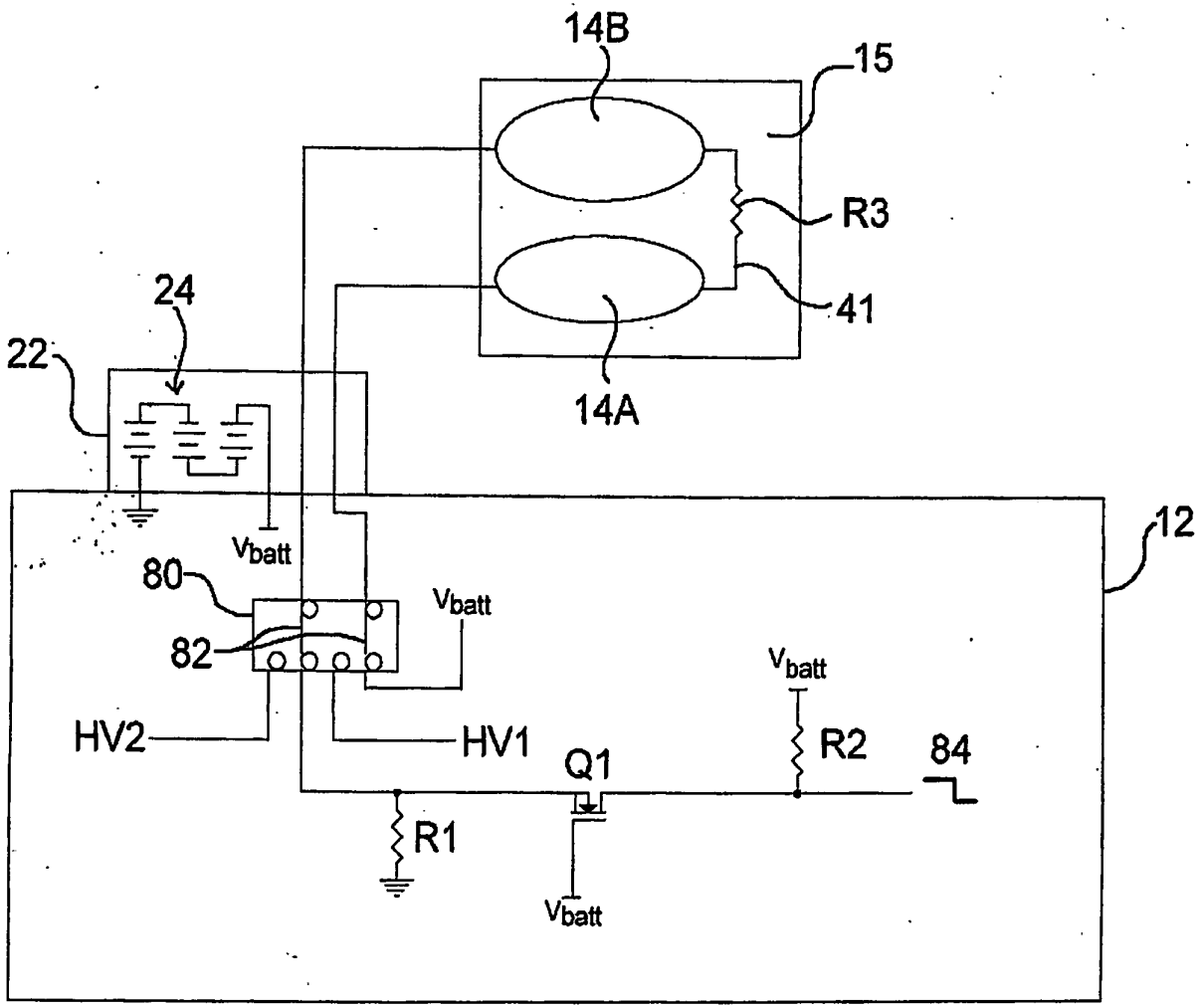
14B
15
R3
41
14A
24
22
12
Vbatt
80
82
Vbatt
Vbatt
HV2
HV1
Q1
R2
84
R1
Vbatt

Fig 4A

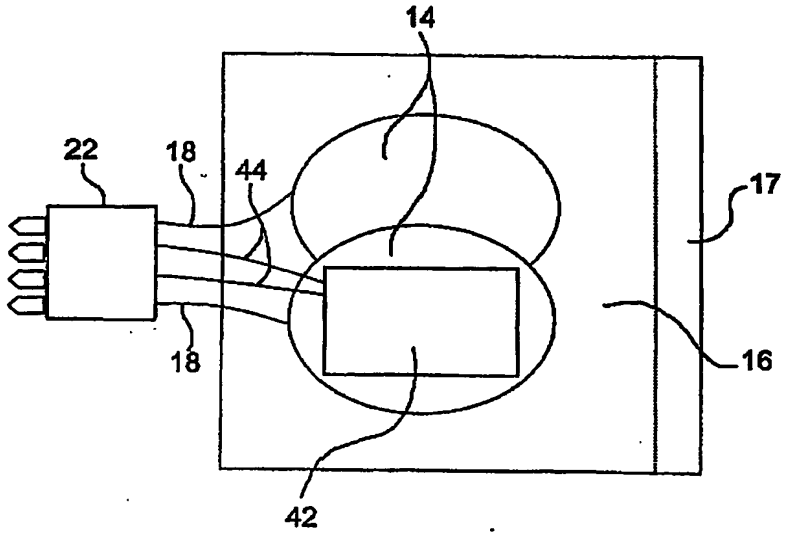

Fig 5

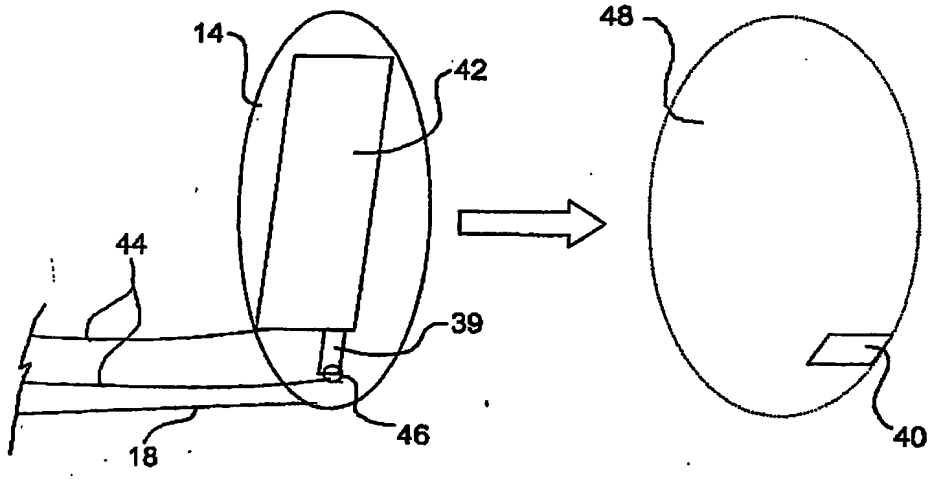

Fig 6

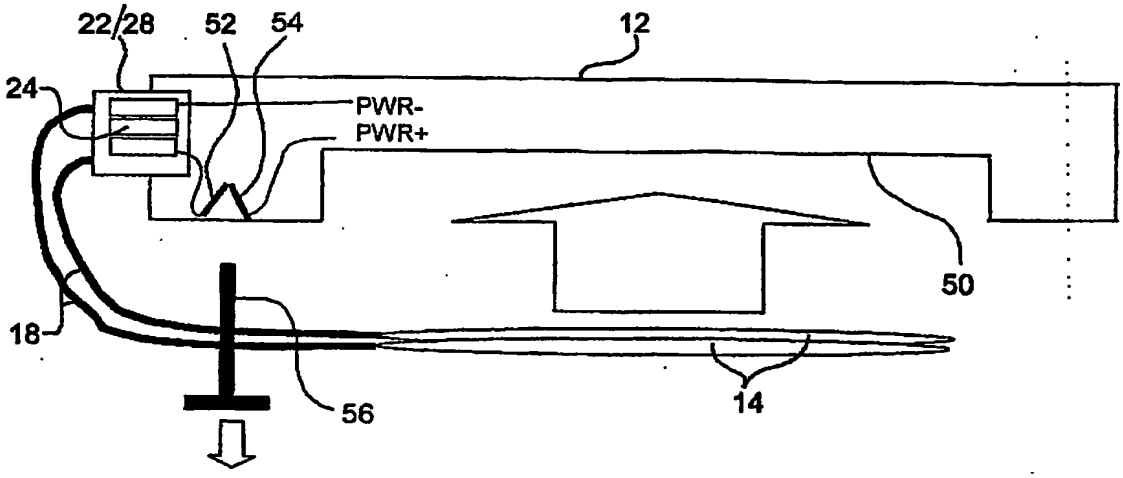
22/28
52
54
12
24
PWR-
PWR+
50
18
56
14

Fig 7

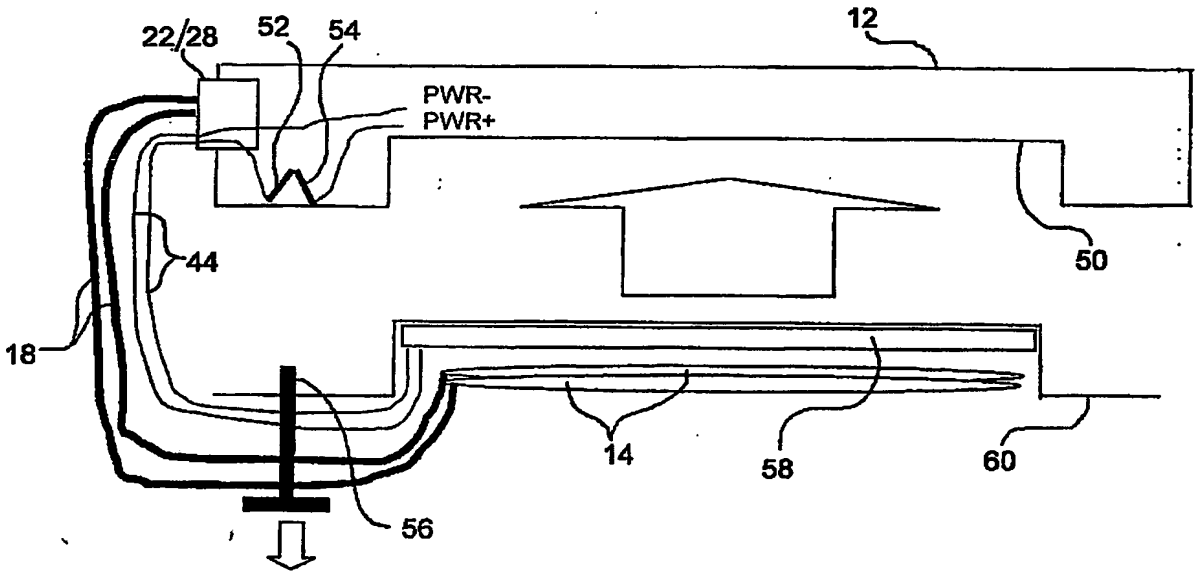
22/28
52
54
12
PWR-
PWR+
50
44
18
14
58
60
56

Fig 8

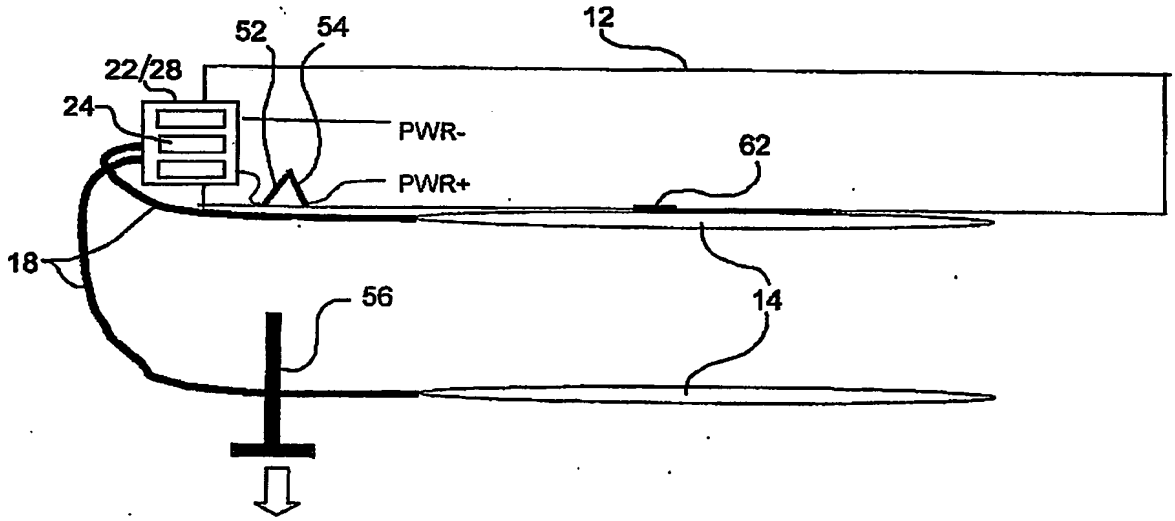

Fig 9

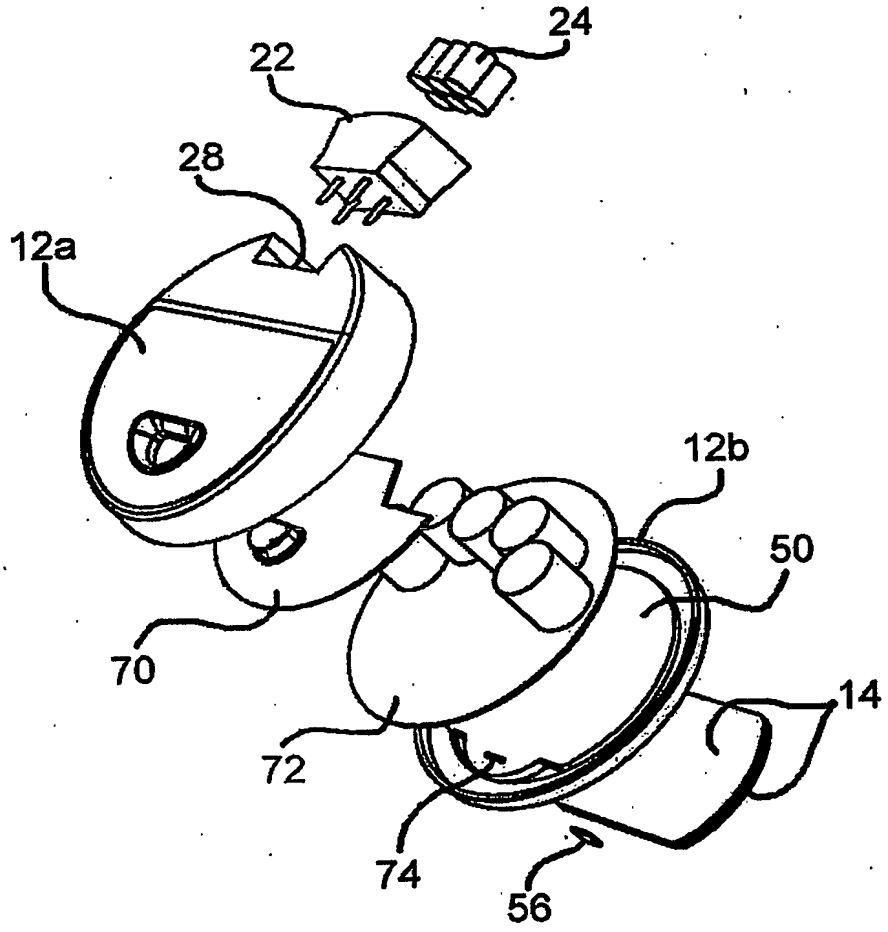

Fig 10